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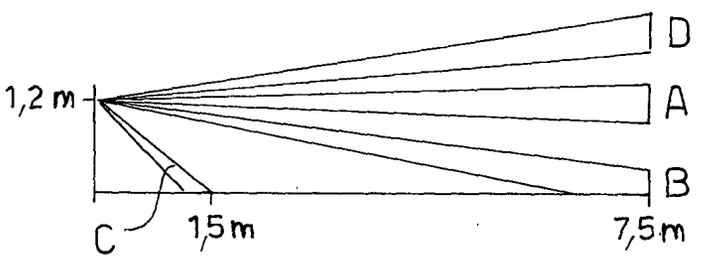
(54) Segmented Fresnel lens

(57) A segmented Fresnel lens with a spherical surface is described, comprising a plurality of Fresnel lens segments able to concentrate the respective detection rays onto an optical sensor (10) disposed in the focal region (11) of the lens, the lens (1) having two bands one above the other (5, 6) on the outside, each with nine plastic segments (S), whilst said Fresnel lens segments or radiation segments are (17) in number, thus distributed from bottom to top on four bands one above the other: three segments in the bottom band (C), five segments in the middle band (B), six segments in the middle band (A) and three segments in the top band (D).

FIG. 4



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Description

[0001] The present invention relates to a segmented Fresnel lens, to be used as concentrator of infrared rays on a light-sensitive element (optical sensor), particularly for application in anti-intrusion systems or in occupancy detection systems in general.

[0002] As is known, infrared occupancy detection devices, or sensors, comprise an element able to collect and concentrate rays to maximise the signal gain and an electro-optical sensor able to receive the radiation signal.

[0003] Associated with the sensor is electronic circuitry able to detect fluctuations in the output signal from the sensor which are the result of the variations in the radiation signal.

[0004] The principle on which these passive infrared sensors are based is the following.

[0005] Since people and objects in general normally have temperature differentials with respect to the surrounding environment, they emit levels of infrared radiation that generally differ from the background levels. Consequently, they produce fluctuations in the intensity of radiation when they pass through the optical field which, suitably amplified, can be detected by the electronic circuitry associated with the sensor.

[0006] Using said radiation concentrators, temperature differentials of less than one degree Celsius are sufficient for the presence of a moving person or object to be detected.

[0007] Fresnel lens or segmented Fresnel lens, that is lens consisting of a plurality of bands or segments of Fresnel lens, each of which is able to cover a certain zone of the room to be monitored, are usually used as radiation concentrating elements.

[0008] US 4 930 864 describes a domed system of segmented Fresnel lens associated with an infrared occupancy sensor.

[0009] The system of lens comprises a plurality of segments of Fresnel lens distributed on the surface of a spherical hood, each able to receive the radiation from a distinct zone centered around a corresponding optical axis and focus it in the focal region.

[0010] Italian utility model No. 218696 filed on 10 August 1987 describes a similar sensor with a segmented Fresnel lens, able to be inserted in a standardized wall-mounted boxes for holding electrical modules.

[0011] EP-0484293 describes an infrared occupancy sensor comprising a hood lens with a plurality of segments of Fresnel lens disposed in three bands one on top of the other to cause the radiation coming from the upper part, the central part and the lower part, respectively, of the room being monitored to converge on the infrared sensitive element. In the solutions of the prior art a visual correspondence normally exists between the segments of the Fresnel lens formed on the plastic hood and the corresponding segments or ray beams that are directed onto the sensitive element by said plastic segments. This allows easy identification of the direction of the rays even at a distance.

[0012] Furthermore, the arrangement of the bands determined by the Fresnel lens segments does not always offer an absolute barrier to intercept any attempt at intrusion.

[0013] The object of the invention is to eliminate the drawbacks of the solutions of the prior art.

[0014] In particular, one object of the invention is to provide a segmented Fresnel lens in which there is no visual correspondence between the beams of radiation and the plastic segments, so as to hide the direction of the beams.

[0015] Another object of the invention is to provide such a segmented Fresnel lens with an orientation of the beams that allows the creation of a complete barrier able to intercept any attempt at intrusion into the room monitored by the sensor combined with the lens.

[0016] The above objects are achieved by the segmented Fresnel lens according to the invention, which has the characteristics of appended independent claim 1.

[0017] Advantageous embodiments of the invention are set forth in the dependent claims.

[0018] Essentially, the lens according to the invention comprises two horizontal bands of plastic segments, to which four horizontal bands of radiation segments or radiation beams correspond. There is therefore no correspondence between the plastic segments and the radiation segments or intercept beams.

[0019] The four bands of radiation or intercept segments are of different vertical sizes and are divided into a different number of segments.

[0020] In particular, starting from the bottom, the first band has three segments, the second five, the third six and the fourth three.

[0021] The angular horizontal extension of the field of coverage of the lens is about 112 degrees, whilst the angular vertical extension is about 36°, plus 6° on the horizontal and -30° beneath the horizontal.

[0022] The first and lowest band has a coverage limited to a maximum of 1.5 metres, whilst the others create a barrier at about 7 metres.

[0023] The third band from the bottom with six segments has practically no inclination with respect to the horizontal.

[0024] Further characteristics of the invention will be made clearer by the detailed description that follows, referring to a purely exemplary and therefore non-limiting embodiment thereof, illustrated in the appended drawings, in which:

Figure 1 is a diagrammatic axonometric view of a segmented Fresnel lens according to the invention;

Figure 2 is a development of the lens of Figure 1;

Figure 3 is a top plan view showing the angular cov-

erage of the lens on the horizontal plane;

Figure 4 is a side view showing the angular coverage of the lens on the vertical plane.

[0025] With reference to said figures, and for now in particular to Figures 1 and 2, the lens according to the invention has been designated as a whole with reference numeral 1.

[0026] The lens 1 according to the invention is called a segmented Fresnel lens because it consists of a plurality of segments or lenghts of Fresnel lens, as will be described better hereunder.

[0027] The lens 1 proper, as shown in Figure 1, has a spherical surface and is supported by a box-shaped body 2 consisting of pairs of flat opposite facing walls.

[0028] The lens 1 and the supporting body 2 are normally formed in a single body by molding of plastic material.

[0029] As can be seen schematically in Figure 1, guides 3 and coupling means 4 for fixing of the lens, for example to an electrical module that can be inserted in a wall-mounted box, are provided on the body 2.

[0030] As shown diagrammatically in Figure 1, the lens 1 is geometrically divided by a line L into two horizontal bands 5, 6, each comprising nine plastic segments, seen better in the development of Figure 2. The plastic segments, diagrammatically indicated with S in Figures 1 and 2, related to the external geometry of the lens, do not correspond to the same number of optical segments, that is, radiation segments.

[0031] On the contrary, as can be seen in Figure 2, and better in Figures 3 and 4 which illustrate the angles of coverage of the lens, the two bands 5 and 6 of plastic segments S coincide with four bands A, B, C, D of radiation segments, of which the corresponding foci F_A, F_B, F_C and F_D are shown in Figure 2.

[0032] In particular, proceeding from bottom to top, band C comprises three radiation segments, band B five segments, band A six segments and band D three segments again.

[0033] The lack of visual correspondence between the plastic segments S and the radiation segments makes it possible to hide the direction of the radiation beams. This is especially useful in anti-theft applications.

[0034] The orientation of the radiation beams which are directed into the focal region 11 of the lens (shown hatched in Figure 2), where an optical sensor 10 is disposed, can be seen from Figures 3 and 4.

[0035] In particular, considering that the sensor, in normal wall-mounted box installations, is disposed at a height of about 1.2 metres from the ground, the lower band C is directed downward and has an extension of about 1.5 metres (Figure 4) with an angular coverage on the horizontal plane of about 75°.

[0036] The remaining three bands B, A and D create a barrier at about 7.5 metres and overall determine an angular coverage, on the horizontal plane, of about 112 degrees.

[0037] Figure 3 shows the radiation beams corresponding to the segments of the different bands A, B, C and D.

[0038] As can be seen from Figure 4, the angular extension on a vertical plane is about 36°, with an inclination of+6° upward and -30° downward. Band A with six segments, the third from the bottom, has no inclination with respect to the horizontal, so as to determine the greatest concentration of rays at the typical intercept height for a person, corresponding to the level of installation of the sensor, that is, about 1.2 metres.

[0039] The division of the lens into four radiation bands, with a total of 17 segments, makes it possible, compared with conventional solutions, to have a greater angular coverage both on the vertical and on the horizontal, the geometrical size of the lens remaining the same.

[0040] The creation of a barrier able to intercept anyone who approaches the sensor is in any case ensured.

[0041] The advantages of the segmented Fresnel lens according to the invention are obvious from the above description, but its construction is nevertheless not limited to what has been described and illustrated in the annexed drawings, but is liable to numerous modifications of detail within the reach of a person skilled in the art, without departing from the scope of the invention, as set forth in the claims that follow.

Claims

1. A segmented Fresnel lens with a spherical shape, comprising a plurality of segments of Fresnel lens able to concentrate respective beams of radiation onto an optical sensor (10) disposed in the focal region (11) of the lens, and having a plurality of bands (5, 6) of plastic segments (S), one on top of another (5, 6), **characterized in that** no direct correspondence exists between said plastic segments (S) and said Fresnel lens segments or radiation segments, able to concentrate the radiation onto the sensor (10).

2. A segmented Fresnel lens according to claim 1, **characterised in that** it comprises two bands (5, 6) of plastic segments (S) and four bands (A, B, C, D) of radiation segments.

3. A segmented Fresnel lens according to claim 1 or 2, **characterised in that** it comprises eighteen plastic segments (S) and seventeen radiation segments.

4. A segmented Fresnel lens according to claim 3, **characterised in that** said seventeen radiation segments occupying the four bands one on top of

another, proceeding from bottom to top, are thus distributed: three in the lower band (C), five in the middle band (B), six in the middle band (A) and three in the upper band (D).

5. A segmented Fresnel lens according to any one of the preceding claims, **characterised in that** the angular coverage of said radiation segments, in a horizontal plane, is about 112°.

6. A segmented Fresnel lens according to any one of the preceding claims, **characterized in that** the angular coverage of said radiation segments in a vertical plane is about 36°, + 6° above the horizontal and - 30° below the horizontal.

7. A segmented Fresnel lens according to claim 4, **characterized in that** said band (A) with six radiation segments has no inclination with respect to the horizontal.

8. A segmented Fresnel lens according to claim 4, **characterised in that** said lower band (C) has a coverage of about 1.5 metres in distance, whilst the remaining three bands (B, A, D) create a barrier at about 7.5 metres.

9. A Fresnel lens according to any one of the preceding claims, **characterised in that** it has a box-shaped body (2) and is mounted together with said optical sensor (11) and the relative control electronic circuitry in a wall-mounted box at a height of about 1.2 metres.

10. An infrared occupancy sensor comprising a segmented Fresnel lens (1) able to concentrate detection radiation on a sensitive element or optical sensor (10), with which control electronic circuitry is combined, **characterised in that** said segmented Fresnel lens (1) has characteristics according to any one of claims 1 to 9.

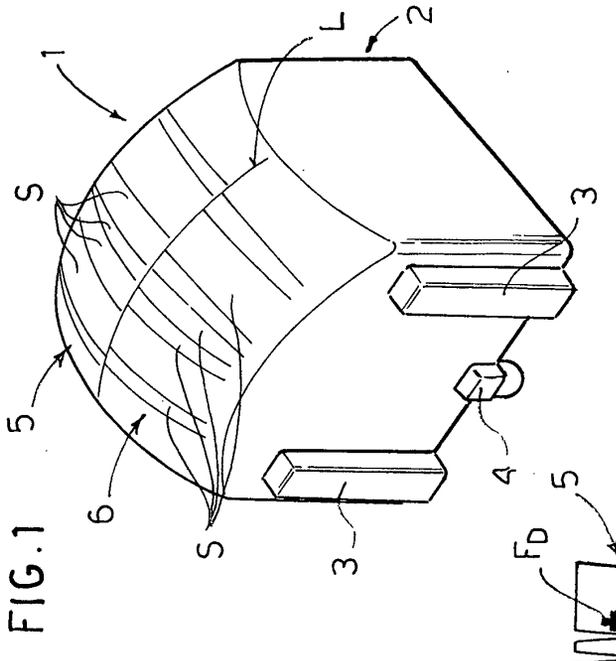

FIG.1

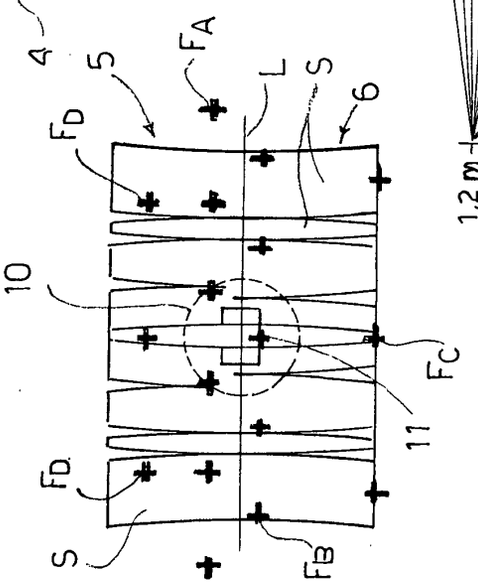

FIG.2

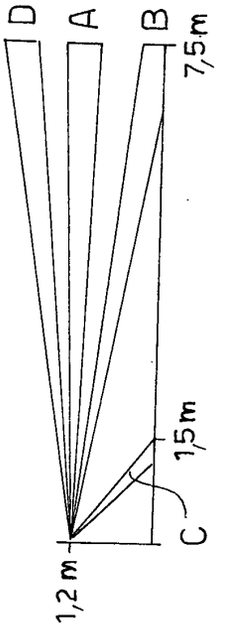

FIG.4

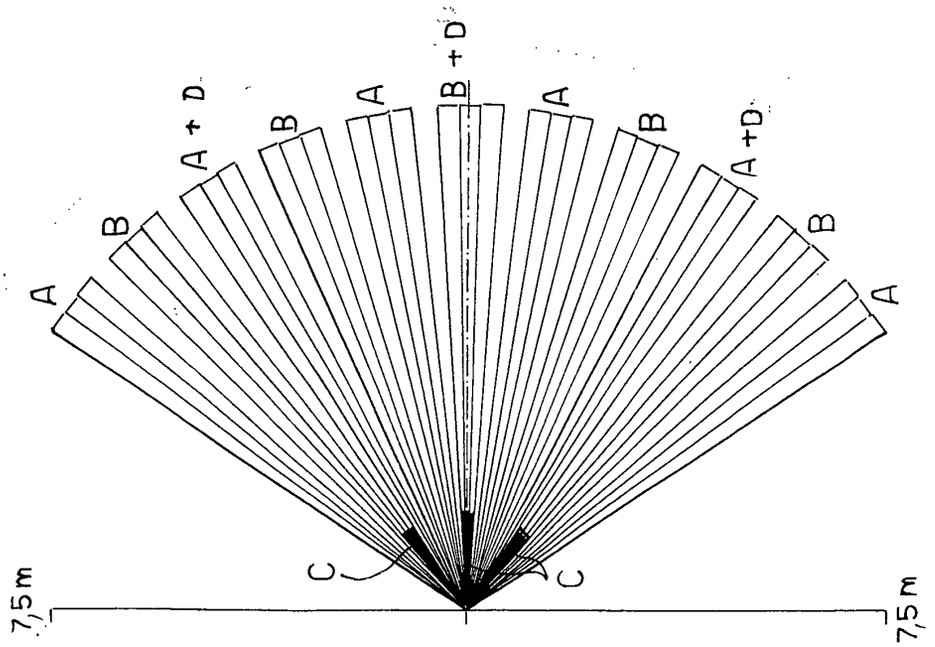

FIG.3